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Procedia Manufacturing 3 (2015) 3917 – 3924

Procedia MANUFACTURING

6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015

Crisis management simulations: Lessons learned from a cross-cultural perspective

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Abstract

Emergency crisis management is a highly dynamic and complex domain. It challenges performance and increases reliance on information, technology, people and context. Crisis events are something to which all nations must respond, however processes, policies, and responses to those events may be culturally defined. Culture, described as a set of characteristics, values and behaviors manifested within a group of people and shaped by historical experiences means that cognition can no longer be thought of as being universally the same across populations. To explore the role of culture within decision-making and distributed cognition, an initial collaborative pilot study was undertaken with the University of Manchester. The goals were to collect case data on the strength of cognitive and behavioral variables related to culture as it is operationalized within the NeoCITIES emergency response simulation. The study purported to test the influence of a naturalistic culture (U.S. and U.K.), hidden knowledge, and time stress on team performance to provide an initial understanding of how culture impacts cognition within an emergency crisis management setting. This initial study was a successful proof of concept that NeoCITIES could be used in an international comparative experiment. Although we did not achieve results with our initial pilot study, several significant lessons were learned in carrying out this cross-cultural research.

Peer-review under responsibility of AHFE Conference

*Keywords:*Team cognition; Simulation; Cross cultural research; Lessons learned

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Peer-review under responsibility of AHFE Conference
doi:10.1016/j.promfg.2015.07.918

1. Introduction

Situated, distributed cognition within our global society is prevalent owing to new social technologies, which facilitate problem solving and communications across distances. Teams are often employed in these settings to deal with complex and emergent problems across a variety of domains. Crisis management, for example can be thought of as socially distributed cognition that is necessarily teamwork focused and emergent over time as new elements of the context are revealed and become salient to the intentions at hand. As part of the new world order of socio-technical systems, we surmised that culture and beliefs play a prominent part in how distributed cognition plays out in various domains, and particularly in teamwork. “Common in many of the definitions [of culture] is the notion that culture is a whole set of symbolic resources of a given community, such as lay theories, icons, scripts, and schemas (Adams & Markus, 2004). The symbolic resources of culture are accumulated and transmitted across generations and are usually externalized into social practices and social institutions”[1, p. 138].

The intent behind our research then was to utilize the Living Lab framework to understand how forms of culture might differentially impact team performance within emergency crisis management situations [2]. A major part of this approach was the utilization of NeoCITIES, a human-in-the-loop, scaled world simulation [3]. We had an opportunity to conduct the simulation with British students at the University of Manchester as well as American students at Pennsylvania State University to potentially enable contrast and comparisons of two distinct cultures. While this opportunity provided a great deal of promise to help understand how distributed cognition might vary when team members from differing countries participate, the actual development and implementation of the study and simulation in another country provided ample insights into practical difficulties than can ensue. While part of this paper elaborates the foundation and basis of a cross-cultural comparison, a main objective is to (1) reflect on many of the issues, problems, and constraints that emerge when all the details and considerations are laid out; (2) project lessons learned and answers for future researchers in this arena to consider when engaging in cross-cultural research and international work; and (3) to enable future considerations of cross-cultural and intercultural work within crisis management as socially distributed and socially constructed cognitive work. The paper begins with research history and foundations, and then continues with methods and reflections about practical aspects of this research.

2. Research foundations

Across many domains, teams are employed to carry out tasks in order to address complex problems. A team is defined as "a distinguishable set of two or more people who interact dynamically, interdependently, and adaptively toward a common and valued goal/object/mission, who have each been assigned specific roles or functions to perform, and who have a limited life span of membership"[4, p. 4]. In many instances, teams must interact and engage in problem solving with teams from different cultures. Oftentimes, these multicultural interactions can be fraught with misunderstandings for both team members and for organizations. As such, it is important to understand the ways in which culture impacts individual and team cognitions. However, often this work is underrepresented in the literature as cross-cultural and cross-site research can represent a significant effort to carry out, not only due to the complex nature of examining culture in an experimental setting, but also in the logistical requirements inherent in using multiple populations from different nationalities.

Likewise, the domain of emergency crisis management is highly complex, changing in ways that challenge performance, and becoming increasingly reliant on information, technology, people, and context. Unfortunately, crisis management strategies are often not informed by principles of organizational psychology, human factors or team cognition. Similarly, the interfaces and tools designed to facilitate collaboration in a crisis are often technology-centric, haphazard in design, and devoid of any cultural considerations [5]. In many cases, just defining what culture is and how it is measured is daunting, let alone determining how it works as a variable of influence in teamwork [6].

Contemporary emergency crisis management is characterized by multinational responses wherein distributed teamwork is enabled through the use of an array of collaborative technologies[5]. Yet we have seen that culture leaves its mark on real world situations that involve crises, impacting the way people interact, how they view the world, and how they process information and enact biases. Culture, described as a set of characteristics, values and

behaviors manifested within a particular group of people who share a sense of belonging to that group, effectively shapes the perspectives and processes of behavior for human cognition [7]. Furthermore, growing evidence suggests that cultural diversity in some way emerges in human cognition, creating diverse cognitive behaviors across different populations [8]. For example, while outcomes of planning activities may be similar Rasmussen, Sieck, and Smart [9]found that processes of planning and expectations in carrying out plans were significantly different between U.S. and U.K. participants. As a result, cognition can no longer be thought of as being universal but is highly situated in context, suggesting that much is to be learned from an inclusion of culture as a variable for study. For example, national culture has shown differing responses for teams involved in crisis management [10], [11]. Before we can discuss how nationalistic culture influences decision-making within a crisis simulation, and utilize cultural influence as a basis for adapting collaborative technologies to improve performance, we have to be able to understand national culture in terms of teamwork and cognition much better. The project and partnership that we have undertaken has allowed us to utilize an intriguing simulation to investigate how teams from different national cultures respond to emerging crisis management scenarios. Additionally it has informed us as researchers on the processes and problems emerging from cross-cultural research in different countries.

2.1. Living Laboratory framework

Our research project was developed from the Living Laboratory (LL) Approach developed by McNeese and colleagues. The LL framework specifically “utilizes observations of humans within their work domain alongside a deeper understanding of their knowledge to aid in the design and implementation of realistic simulations to be used as test theory and technology in a controlled setting” [2, p. 5]. While depicted as a cyclic process (see Fig. 1), the flexibility of the framework allows the processes to be performed in any order. With regard to using NeoCITIES as a simulation platform, historically, the process involved knowledge elicitation from subject matter experts (SMEs) in order to create the simulation scenarios. The researcher-created scenarios were then validated by SMEs and were subsequently used in the scaled-world simulations for the experiment participants in the laboratory.

2.2. NeoCITIES

Developed from the CITIES simulation [12], NeoCITIES is a scaled world simulation centered on team cognition and decision-making in a university campus crisis management environment. It utilizes triad teams, with the roles of Fire, Police and HazMat in the United States, and Fire, Police, and Environmental Services/Army in the United Kingdom to respond to events in fictional scenarios. The use of a scaled-world simulation platform allows for the complexities of a domain, such as crisis response, to be tested with the control of a laboratory environment. For the

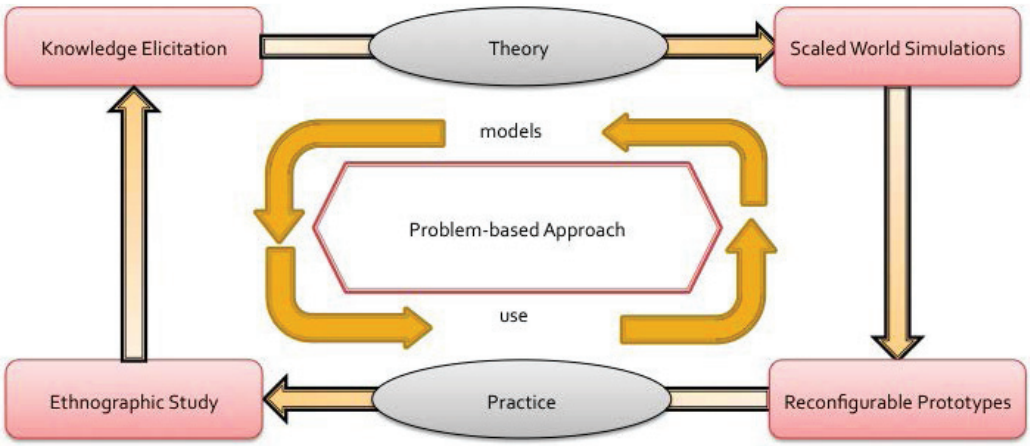

Fig. 1. Visual Representation of the Living Lab Framework [2].

past decade, the NeoCITIES simulation has been used to assess team cognition and decision-making with over 1000 participants [13]. The current study is the first time that NeoCITIES has been deployed in a cross-cultural capacity. Several important practical findings were realized from this initial study, ranging from the practical requirements for setting up and running the experiment to preliminary data that displayed obvious differences between the American and British teams who participated.

2.3. Goals of the study

To explore the role of culture within decision making and distributed cognition, an initial collaborative pilot study was undertaken between Pennsylvania State University and the University of Manchester. The goals were to collect case data on the strength of cognitive and behavioral variables related to culture as it is operationalized within the NeoCITIES emergency response simulation. Furthermore, this initial study was a proof of concept that NeoCITIES could be used in an international collaborative experiment using web architecture (i.e., a client-server architecture available through internet site at select universities within different country locales). The study purported to test the influence of a nationalistic culture (British and American), hidden knowledge, and time stress on team performance to provide an initial understanding of how culture impacts cognition within an emergency crisis management setting.

3. Research activities

3.1. Logistics

The study with the University of Manchester was organized primarily from the Penn State site. Most of our project interactions occurred as distributed communications via email, with some virtual team meetings over Skype and one face-to-face meeting prior to the running of the experiment. The distributed nature of the project presented significant challenges that needed to be overcome.

Organization of the cross-cultural research project across geographically (and temporally) distributed sites required significant time and effort on the part of the researchers, and it required significant project management. This required negotiation of specific cultural differences between the institutions in expectations of:

- Experimental locations (i.e. laboratory space, versus large computer clusters),
- Compensation for the participants,
- Information Technology (IT) distribution of the simulation
- Distribution of related training and instructional materials (i.e. USB drive vs. YouTube video link).

In preparation for deployment of NeoCITIES, the IT group in the U.K. had to create the technological infrastructure similar to the one that existed at Penn State. This process involved the researchers being a liaison between the local American IT department and the British IT group. Once the infrastructure was in place, detailed instructions for installation and deployment were created and sent to the British IT group, which were ultimately responsible for installation, configuring, and securing the system.

3.2. Experimental setting

Beyond forging an inter-institutional partnership between the two universities, one of our primary goals in this research was the establishment of experimental equivalence between the two sites. This in fact presented many challenges and required significant negotiation between the two sites in order to do so.

To create functional equivalence in experimental setting, the simulation was deployed in a large computer cluster environment. This was done due to the lack of dedicated lab space available to run the experiment at the University of Manchester. At the University of Manchester, this was a large space of general use computers; at Penn State it was a computer classroom. We were able to run the experiments at each site about a week apart to limit the impact of any external events.

3.3. Incentives

In order to align incentives between the two groups, an equivalent monetary reward was given to the two groups, adjusted for currency rates. At the U.S.university, 20$ cash was given for student participation (rate of 10$/hr). At the U.K. university, Amazon.co.uk vouchers for 10£ were deemed more in line with university practices. Additionally, at both locations, participants were fed a dinner meal, given the timing of the experiment.

3.4. Recruitment (Manchester vs. PSU)

In the U.S., participants were recruited from several courses in the information science college at Penn State by the researchers visiting each class and providing information about the project and leaving behind a sign-up sheet for interested participants (mean age=21.18, SD=1.662, range=18-24). In the U.K., participants were recruited from a general pool of students in the Mechanical Aerospace Engineering School,using a general inquiry emailed out to participants (mean age=20.25, SD=1.712, range=18-24). In recruiting participants in both countries we put considerable effort in controlling for prior experience in emergency response (either as first responders, military, health workers) and for nationality (given the multinational composition typical of student populations).

3.5. Materials and IT

In order to establish cultural coherence for the U.K. population of the study, NeoCITIES, which was originally written for an American university student audience at Penn State's main campus, had to be scrubbed and rewritten to apply to a British audience. Additionally, the scenarios at both locations were edited to deal with a typical U.K. and U.S. university campus. Scenarios were translated into British English. This process relied on both the main author's prior experience living in the United Kingdom, and through the coordination with our Manchester partners. As a result of these changes, training and instructional materials also had to be converted to British English. A British native was asked to record the specific script that the participants would hear during their experimental training sessions and training videos.

4. Reflections

Implementing the NeoCITIES simulation in a different environment reminded the researchers of the challenges of collaboration and the need for good project management. As a pilot study, the first exercises run outside of the American infrastructure generated some successes while illuminating challenges. Successfully implementing and executing the exercise at the University of Manchester was a positive proof of concept that NeoCITIES is deployable. Indeed, it also allowed for the installation of new perspectives and practices into the experimental design that were not previously considered. For example, the delivery environment at Manchester was a positive. The high volume of noise and commotion in their student computer lab more accurately represented the environment in an emergency operations center during a crisis. At a very basic level, the enthusiasm of the participants for the exercise is indicative of NeoCITIES solid design. Participants' seriousness in performing the exercise, their frustration when challenged by technical weaknesses, and their exercise related communications were significant successes. Anecdotally, the greater on-task communication among British participants as compared to their American counterparts may be attributed to cultural differences although more research is both needed and warranted in this area.

Reflecting on the implementation and use of NeoCITIES also exposed challenges in scenario adaptation, participant recruitment, and scenario delivery including technical and facility issues. Some of these were attributable to simply developing a new laboratory space and others resulted from time and geographic differences that were not fully understood before the pilot. But, it also is important to recognize the different cultural perspectives both in terms of the exercise's context and content and its operations. Few, if any, of the challenges were insurmountable and might have been corrected using a more robust project management approach to the installation and use of the exercise.

The first cultural challenge was apparent in the adaptation of the scenario content to the British environment. In addition to changing wording to reflect the differences in language, the more important aspect of adaptation was altering context to improve relevance for the British participant. There were formal or structural differences of the environments such as which agency had responsibility for responding to a hazardous waste clean up. In the United States fire departments often have HazMat response capabilities, in Great Britain this responsibility rests with the Army and Environmental Services. Beyond cultural differences in the structural organization of crisis response agencies, cultural differences also existed in participant responses to events or actions might be understood or played out in a different environment. Correcting these structured and unstructured differences may be overcome with collaboration but time constraints, distances, and personnel schedules precluded this from happening.

Second, greater information sharing at Manchester may have positively influenced expectations of the American researchers. We did well identifying that the timing of the exercise in the academic semester was important but geographical and temporal distance again precluded optimum timing. More importantly, American researchers failed to understand, until after the exercise, that typical student participation in experiments at Manchester is about 50% of those who register. The failure to understand this phenomenon resulted in higher expectations in terms of collecting viable data than occurred.

Third, the operational environment of the exercise illustrated the importance of testing the technical infrastructure and providing clear instruction to the participants. A system test may have identified problems within the scenario operation such as the participants' inability to allocate resources at certain points in the exercise. An example of the latter was trying to execute an online student orientation rather than doing a group orientation with hard copy material. Again, identifying these vulnerabilities and understanding ways to move forward were a positive effect of the pilots.

In conclusion, better project management that insures more time and resources would improve planning the experiment is a critical finding. Reasonable timelines, defined deliverables, and increased resources for face-to-face collaboration are necessary to successfully adapt scenario and training materials. Having an understanding of the research environment is also crucial during the planning stages to not only understand the logistical challenges associated with cross-cultural cross-site research, but to understand the resources and constraints on the project, as well. Research of this magnitude hinges on fully understanding the site requirements, the culture, and the resources in terms of both availability and limitation.

5. Discussion

We began our research project to study socially distributed cognition through the implementation of the Living Lab approach, and specific utilization of the NeoCITIES Scaled World Simulation. Much of our development and operational considerations for conducting the research contained cognitive-based action but most importantly the issues, lessons learned, and hindrances that have been identified reinforce the finding that metacognitive activities that are in fact necessary to adapt, adopt, and create a study that would work.

First, metacognitive activities/ practices increase the humans' abilities to transfer or adapt their learning to new contexts and tasks [14], and indeed, learning was one of the major components of our study. Second, another facet of metacognitive activities that complements adapting plans and productions is the ability to repeatedly monitor progress towards an experimenter's intention. Metacognitive monitoring was evidenced throughout our project and study as a kind of checkpoint and negotiation strategy. Often monitoring information that was introduced to team members produced points where understanding was tested, refined, and negotiated. A lot of what we did, as part of the socially distributed cognitive process, was to create a meaningful understanding of issues along the way. Third, metacognitive activities rely on (1) meta-memory wherein a person has introspective knowledge and self-control of their own memory; and (2) transactive memory, where memory is distributed and externally stored with other team members. Both of these activities are important for adaptive learning and flexing of plans as well as monitoring 'what you think you know'.

When these metacognitive activities and practices are brought into the social distributive context they get reified and articulated towards the joint intentions of the team. This is where change took place and where reflections across the team produced the liquidity necessary for equilibration. Many iterations within articulated work produce tangible outcomes that all may agree on or at least produce levels of acceptable compromise that can be lived with.

The final study is representation of a tangible outcome of equilibration that allowed the details of the study to be operationalized as a final set of constraints that were then implemented into an actual study.

Metacognition in socially distributed contexts is a useful means for understanding change in terms of how it affects the actions of an experimenter. As we discovered, change necessary in cross-cultural studies is often required as the context of an experiment is not routine but different from past experience and cases. Stated another way, it is contingent upon the team(s) to develop new,shared mental models and to evolve a common operational picture that makes sense and is meaningful to all participants. This takes time and effort to exact. Up until this point our research work had been conducted within the context of a United States government or university lab, primarily within the confines of where we work.

Many of the cases that we draw our experience from are collocated, face-to-face interactions with minimal to moderate variance study-to-study. When working outside of one's own context in a different country, many things taken for granted from previous routine cases, have to be rethought and reconnected to make sense and have meaning across cultures. This is the ironic component of reflections. In essence, the cognitive and metacognitive plans and actions needed to pull off studies in the U.S./U.K. resulted in exactly what we were intending to study experimentally: socially distributed cognition. The necessary coordination, communication, and control components of the study required shared information, articulation, and negotiation on a number of levels. The distributed team of researchers had to develop a common operation picture that encompassed joint effort, effective interactive roles of 'who would do what when - with what piece of information, tool, program, or interface', and continue communicating 'what is' in order to be on the same page, and to effectively tie-down the loose ends to make the study viable.

Teamwork consisted of coordination across the two sites based on specific functional areas, and resulted in the development of sub-teams. This team of teams approach allowed us to divide the work and focus on specific tasks for implementation of the experiment at each site. For example, our overall project team needed to know what was being controlled at the console and needed to understand how the simulation would be facilitated by the given server architecture for the technology infrastructure. Through division of these tasks, management could occur across all levels of the project. Hence, teamwork is specified and transactive via both collocated and distributed information exchange and sharing.

The role of culture, itself, interjected influences that required metacognitive thinking about what we were doing or trying to study. Often we had to subsumethe role of another cultural perspective in order to think about what a response would be or how language or rewards would be interpreted (i.e., is there a difference from one culture to another that would unduly influence control variables, wording of the scripts, interpretation of crisis events, and so on). Much behind the scenes work is required to get the studies up and running. Also, even things like recovery from miscues or mistakes might have different social consequences associated with them, owing to culture and social practices within a given area (e.g., engineering practice is different from psychological science practice).

In summary, the work we set out to do experimentally became the work we experienced empirically. There are many considerations that have to be taken into account when conducting an experimental study that involves cross-cultural cognitive processes. We have identified some of the issues and constraints that we experienced as part of our learning and continuous process improvement. Hopefully, what has been shared will be useful for other researchers undertaking similar endeavors.

Acknowledgements

We would like to acknowledge and thank our colleagues, Professor Andrew Gale, Professor Margaret Emsley, and Francesca Demontis for their support in carrying out the current research.

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